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APPLICATION NUMBER: 60/491,594 ✓

FILING DATE: July 31, 2003 ✓

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# PROVISIONAL APPLICATION COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION under 37 CFR 1.53(b)(2).

Docket Number

US030255

Type a plus sign (+)  
inside this box ☐

INVENTOR(s) / APPLICANT(s)

LAST NAME

FIRST NAME

MIDDLE INITIAL

RESIDENCE (CITY AND EITHER  
STATE OR FOREIGN COUNTRY)

NANDAGOPALAN

SAISHANKAR

TARRYTOWN, NY

TITLE OF THE INVENTION (280 characters max)

METHOD TO PROVIDE FAIRNESS AND TIME AND FAIRNESS IN BANDWIDTH IN  
IEEE 802.11 WIRELESS LOCAL AREA NETWORKS (WLAN)

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STATE

New York

ZIP CODE

10591

COUNTRY

U.S.A.

ENCLOSED APPLICATION PARTS (check all that apply)

☒

Specification

Number of Pages

2

☐

Small Entity Statement

☐

Drawing(s)

Number of Sheets

☐

☐

Other (specify)

METHOD OF PAYMENT (check one)

☐

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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒

No

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Yes, the name of the U.S. Government agency and the Government contract number are:

Respectfully submitted,

SIGNATURE:

*St R Biren*

Date:

<sup>31</sup>  
~~JULY 29~~, 2003 *E.C.*

TYPED or PRINTED NAME: STEVEN R. BIREN

REGISTRATION NO.: 26,531

☐

Additional inventors are being named on separately numbered sheets attached hereto.

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## **Introduction**

IEEE 802.11 Medium Access Control (MAC) [3] devices available today works on the DCF protocol. All frames that arrive at the MAC are treated equally and there is no way that service differentiation is provided. All frames, irrespective of the flows, are treated in the same manner. So in order to have QoS satisfied for QoS flows we need a efficient way to set transmit multiple frame and differentiate frames from the conventional data frames (conventional data frames are not QoS flows). In this disclosure we explain how to use the concept of Airtime fairness [4] using the more fragment bit and how to identify frames without doing signalling (because signalling violates the WiFi compliance). The idea of this invention is to show that this can be implemented easily in today's APs (namely Philips AP) and can interoperate with any other vendor's device without violating the IEEE 802.11 standard and compromising on interoperability. This is similar to the IEEE 802.11e [1] TXOP bursting but is novel as it is the first disclosure that uses the IEEE 802.11 legacy MAC and provides transmission of multiple frames.

## **Invention**

In the IEEE 802.11 MAC [2] if the frame is too large to be transmitted successfully, it is fragmented so that the probability of error because of the impairments of wireless channel is reduced resulting in increased success probability of that fragment than the frame. For example if the frame size is 1500 bytes and if the AP or STA determines that it is not possible to transmit this frame as whole successfully it may fragment the frame into 3 fragments each of size 500 bytes. The probability of success increases for small frames is more than the probability of success for large frames given that we know this error probability. Now the AP or the STA transmitting the fragment does not access the medium 3 times but sets the more fragment bit wherein all the frame are sent successively after a Small Inter Frame Space (SIFS) time.

We use this more fragment bit to transmit multiple frames in IEEE 802.11 DCF downlink for QoS streams like audio and video. Today audio and video streams are transmitted using the higher layer protocol called real time protocol (RTP). Whenever the IEEE 802.11 AP receives a downlink frame from the infrastructure, it will scan the frame for the higher layer header. If it finds that the higher layer protocol is TCP then it does operate as normal AP. On the contrary if it finds that the higher layer protocol is RTP it needs to understand the RTP header wherein the information on the type of QoS stream is available and use that information to invoke the wild card filter to determine the traffic characteristics. For example if it is stereophonic audio it is 128 kbps, if it is MPEG2 video, the traffic rates can be easily extracted using wildcards that are present today in Windows 2000 machines that use Resource reservation protocol (RSVP), Sun Workstations and Linux OS. Once the traffic characteristics is found, the protocol calculates the airtime requirement [6],[3] for that stream and initialises an airtime counter for each downlink stream. Once the medium is accessed by the AP, it will use the TWFP algorithm [5] to determine which stream will get a chance to transmit without violating the QoS characteristics of other streams. From that it will know the airtime share and set the airtime counter of that stream. Until the airtime counter is not zero it will set the more fragment bit of the frames of that flow to enable the fair airtime share that satisfies the QoS requirements of that stream.

## **Implementation Aspects**

To accomplish this we need one airtime counter per stream that is implemented at the AP using hardware, firmware or driver software. We also need the wildcards that can be easily implemented in the device driver to



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determine the traffic characteristics of the downlink stream. If the RTP header indicates it is a MPEG 2 video we invoke the MPEG2 wildcard filter and use the predefined traffic characteristics to allocate air time to that flow. If it is a HDTV flow then we need to invoke HDTV wildcard filter. How to implement the wild card filters can be easily understood from the open source code of Linux OS. Then we need to identify all possible streams and map their characteristics so that the AP can understand today's multimedia stream characteristics. Once the traffic characteristics are known, we use algorithms [5],[6] and invoke the airtime counter accordingly. The airtime counter determines how long a stream can set the more fragment bit for a flow, thus granting multiple frame transmissions in a single access and thereby guaranting the QoS requirements of that flow. This algorithm is implemented at the AP only and is standards compliant and provides a differentiating mechanism for devices that implement this algorithm from those who don't implement it.

## References

- [1] IEEE 802.11e/D4.3, Draft Supplement to Part 11: Wireless Medium Access Control (MAC) and physical layer (PHY) specifications: Medium Access Control (MAC) Enhancements for Quality of Service (QoS), May 2003.
- [2] IEEE Std. 802.11-1999, *Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications*, Reference number ISO/IEC 8802-11:1999(E), IEEE Std. 802.11, 1999 edition, 1999.
- [3] ID 703696 - An Efficient Admission Control Algorithm for IEEE 802.11e
- [4] ID 703697 - Fairness in Time - A new Phenomenon in Wireless LANs
- [5] TP-WFQ Algorithm for IEEE 802.11e - Deliverable to Philips Semiconductors
- [6] Efficient Admission Control Algorithm for IEEE 802.11e - Deliverables to Philips Semiconductors



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Atty. Docket

SAISHANKAR NANDAGOPALAN

US 030255

Serial No.

Filed: CONCURRENTLY

Title: METHOD TO PROVIDE FAIRNESS AND TIME AND FAIRNESS IN  
BANDWIDTH IN IEEE 802.11 WIRELESS LOCAL AREA NETWORKS (WLAN)

Commissioner for Patents  
Alexandria, VA 22313

APPOINTMENT OF ASSOCIATES

Sir:

The undersigned Attorney of Record hereby revokes all prior appointments (if any) of Associate Attorney(s) or Agent(s) in the above-captioned case and appoints:


STEVEN R. BIREN

(Registration No. 26,531)

c/o PHILIPS ELECTRONICS NORTH AMERICA CORPORATION, Corporate Intellectual Property, 580 White Plains Road, Tarrytown, New York 10591, his Associate Attorney(s)/Agent(s) with all the usual powers to prosecute the above-identified application and any division or continuation thereof, to make alterations and amendments therein, and to transact all business in the Patent and Trademark Office connected therewith.

ALL CORRESPONDENCE CONCERNING THIS APPLICATION AND THE LETTERS PATENT WHEN GRANTED SHOULD BE ADDRESSED TO THE UNDERSIGNED ATTORNEY OF RECORD.

Respectfully,

  
Michael E. Marion, Reg. 32,266  
Attorney of Record

Dated at Tarrytown, New York  
on July 29, 2003.

PATENT APPLICATION SERIAL NO. \_\_\_\_\_

U.S. DEPARTMENT OF COMMERCE  
PATENT AND TRADEMARK OFFICE  
FEE RECORD SHEET

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